Energy Research and Development Division
FINAL PROJECT REPORT

PLUMAS ENERGY EFFICIENCY AND RENEWABLES MANAGEMENT ACTION PLAN (PEER MAP)

Appendix D: Feasibility Study for Biomass Heat at the Plumas National Forest Supervisors Office and Mount

Prepared for: California Energy Commission
Prepared by: Sierra Institute for Community and Environment

NOVEMBER 2016
CEC-500-2016-067-APD

DRAFT Interim Feasibility Assessment of Biomass Heating and Cooling at Plumas NF Facilities: Supervisor's Office and Mt Hough Ranger District

Plumas, California

July 9, 2013

Prepared for:

Plumas National Forest
US Forest Service

On behalf of:

Sierra Institute for Community and Environment
4438 Main Street
Taylorsville, CA 95983
(530) 284-1022

Prepared By:

Wisewood, Inc.
1001 SE Water Avenue, Suite 255
Portland, OR 97214
Tel. (503) 608-7366
Fax. (503) 715-048

Introduction

The following DRAFT interim report includes work completed to-date on the assessment of the feasibility of converting the US Forest Service Supervisor's Office in Quincy and the Mount Hough Ranger District to utilize biomass energy for space heating and cooling. Due to time constraints, what is presented here is the first pass at the energy analysis, summary cost estimate and financial analysis of the two systems, in spreadsheet and graphical format. In each scenario costs are provided for a turnkey system including the energy generation, distribution and control equipment.

In the case of the Supervisor's Office, opportunities exist for integrating the heating and cooling needs with a potential third-party owned system that would also provide heat to nearby buildings in Quincy. While there was not sufficient time to incorporate that option in this preliminary report, it will be addressed in the final report.

As the analysis of the data gathered at each site is ongoing, it is highly likely that the information presented in this interim report will change, possibly significantly, when the final report is drafted.

Forest Supervisor's Office

Scenario 1: Campus Wide Heating and Cooling

Scenario 1 aims to cover all heating and cooling loads at the Supervisor's office with a combined biomass boiler and water-fired chiller. The model assumed that the heating energy replaced includes all propane and heating oil consumed on-site. Cooling energy to be replaced is currently assumed to be 30,000 kWh/yr, and requires further verification.

A centrally-located boiler/chiller would provide hot water and chilled water via underground pipes (4-pipe) to new air handlers in each of the conditioned spaces on the SO campus.

Fossil energy savings: 1,339 MMBtu/yr
Biomass utilization: 116 tons/yr

Scenario 2: Main Buildings (2000, 2001, 2200, 2301), Heating Only

Scenario 2 aims to cover only the heating loads of buildings 2000, 2001, 2200, 2301 at the Supervisor's office with a biomass boiler system. Heating energy replaced includes 80% of the propane and all heating oil consumed on-site.

A centrally-located boiler would provide hot water via underground pipes (2-pipe) to new air handlers in each of the conditioned spaces on the Supervisor's Office campus. The existing cooling systems would be retained.

Fossil energy savings: 1,186 MMBtu/yr
Biomass utilization: 102 tons/yr

Mt. Hough Ranger District

Scenario 1: Main Buildings (2000, 2361, 2375, 2370), Heating Only

Scenario 1 at Mt. Hough aims to cover only the heating loads of buildings 2000, 2361, 2375, 2370 with a biomass boiler system. Heating energy replaced includes the propane utilized by tanks 8 and 10. Tank 12 propane data is included as a proxy for electric heat in the included buildings.

A centrally-located boiler would provide hot water via underground pipes (2-pipe) to new air handlers in each of the included conditioned spaces on the MHRD campus. The existing cooling systems would be retained.

Fossil energy savings: 562 MMBtu/yr
Biomass utilization: 48 tons/yr

Supervisor's Office

Scenario 1: Campus-Wide Heating and Cooling


N
Lawrence St
89
© 2013 Google
Google earth
Imagery Date: 10/31/2011 39°56'18.41" N 120°56'27.67" W elev 3423 ft eye alt 4040 ft

USFS Supervisor's Office - Quincy

Wood-Fired Heating and Cooling

Energy Calculations

Bldgs: 2000, 2001, 2100, 2101, 2200, 2201, 2300, 2301

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Heating and Cooling
System Output (MBH) 750
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us
Address 1001 SE Water Ave, Suite 255
Portland, OR 97214

Exisiting fossil fuel consumption (MMBtu/HDD)	0.243	Max. electrical demand (kW)	0.5	Current heating oil use, [gal/yr]	3,500
Existing Furnace Eff.	90%	Average electrical demand (kW)	0.3	Current propane use, [gal/yr]	10,991
Calculated exisiting heat input (MMBtu/HDD)	0.219	Annual use (kWhr)	807	Current heating oil cost, [$/yr]	$13,125
Efficiency gains (via EEMs)	0%	Estimated reduction in heating oil use	90%	Current propane cost, [$/yr]	$26,159
Wood Boiler Eff.	85.0%	Boiler output, high-fire (MBH)	750	Projected wood fuel use, [tons/yr]	116
Heating oil cost, $/gal.	$3.75	Boiler output, low-fire (MBH)	150	Projected propane use, [gal/yr]	1,662
Propane cost, $/gal.	$2.38	Average boiler output (MBH)	422	Projected wood fuel use, [$/yr]	$11,576
Electricity cost, $/kWhr	0.17	Wood MC, wet weight basis	25%	Projected heating oil use, [$/yr]	$3,956
Wood fuel cost, $/green ton	$100.00	Energy of Wood, mmBtu/ton, LHV	12.3	Projected electricity cost, [$/yr]	$65
Fossil fuel cost, $/mmBtu	$26.42	Energy of heating oil, Btu/gal, HHV	139000	Operating hours per day	12
Wood fuel cost, $/mmBtu	$8.13	Energy of propane, Btu/gal, HHV	92000	Operating hours, yr	2868

Month	Applicable Heating Degree Days [HDD]	Current gross fossil energy consumption, [MMBtu]	Current net space heat energy input [MMBtu]	Projected net space heat input after EEMs [mmBtu/mo]	Projected gross wood energy consumption, [MMBtu]	Projected gross fossil energy consumption, [MMBtu]
September	163	40	36	36	38	12
October	479	116	105	105	111	20
November	793	193	173	173	183	23
December	942	229	206	206	218	23
January	921	224	201	201	213	19
February	762	185	167	167	176	18
March	737	179	161	161	170	13
April	541	131	118	118	125	8
May	328	80	72	72	76	6
June	231	56	51	51	53	3
July	140	34	31	31	32	3
August	126	31	28	28	29	0
Yearly Total, or Avg.	6162	1,498	1,348	1,348	1,424	149

Net fossil energy savings, [MMBtu/yr] **1,349**

PRELIMINARY

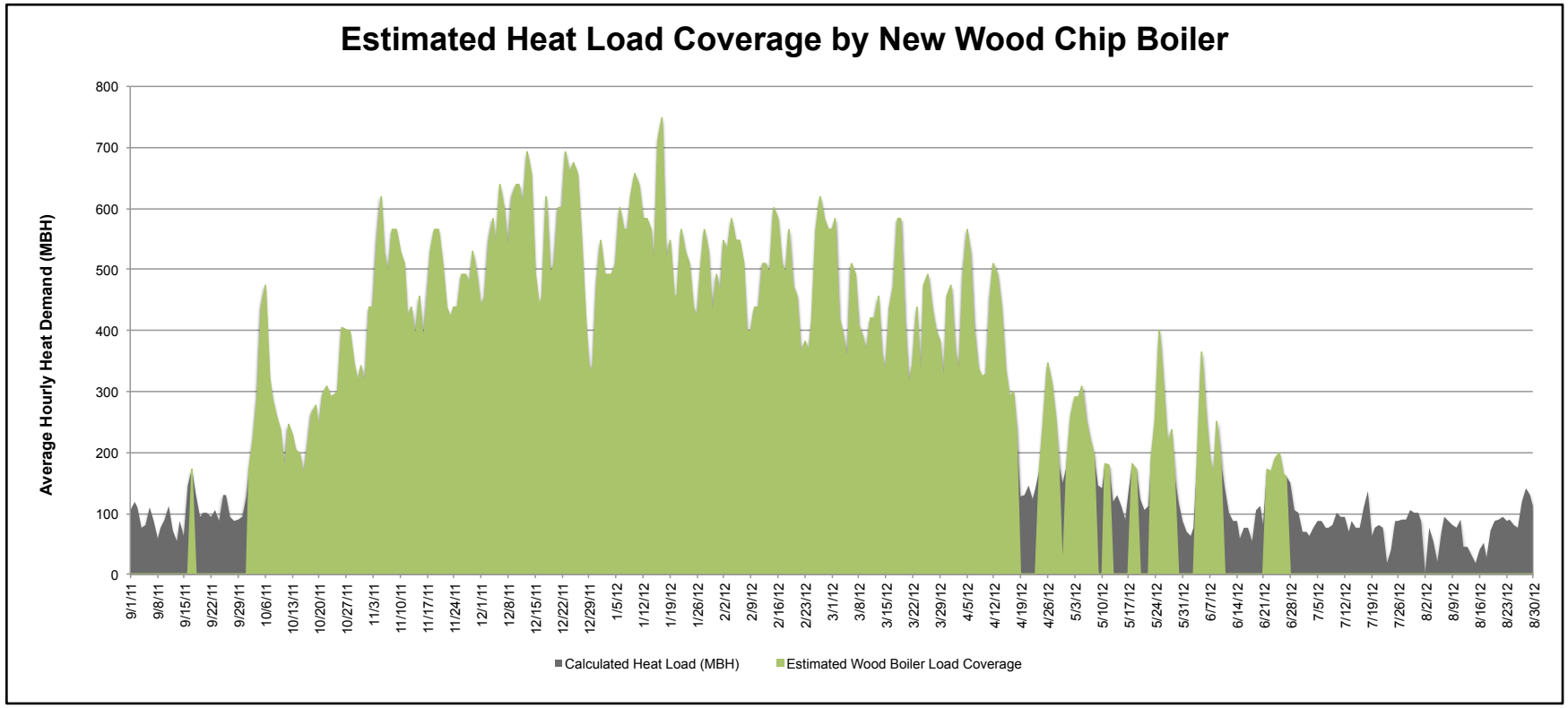
DRAFT - FOR COMMMENT

USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy

Energy Calculations

Project	USFS Supervisor's Office - Quincy	**System Description**	Wood-Fired Heating and Cooling	**Contact**	Andrew Haden
Location	Plumas, OR	**System Output (MBH)**	750	**Phone**	(503) 706-6187
Contact	Earl Ford	**Fuel Type**	Conditioned Forest Biomass (<2" ·	**Email**	andrew@wisewood.us
Date	7/9/13	**Workbook Version**	3.7.1		



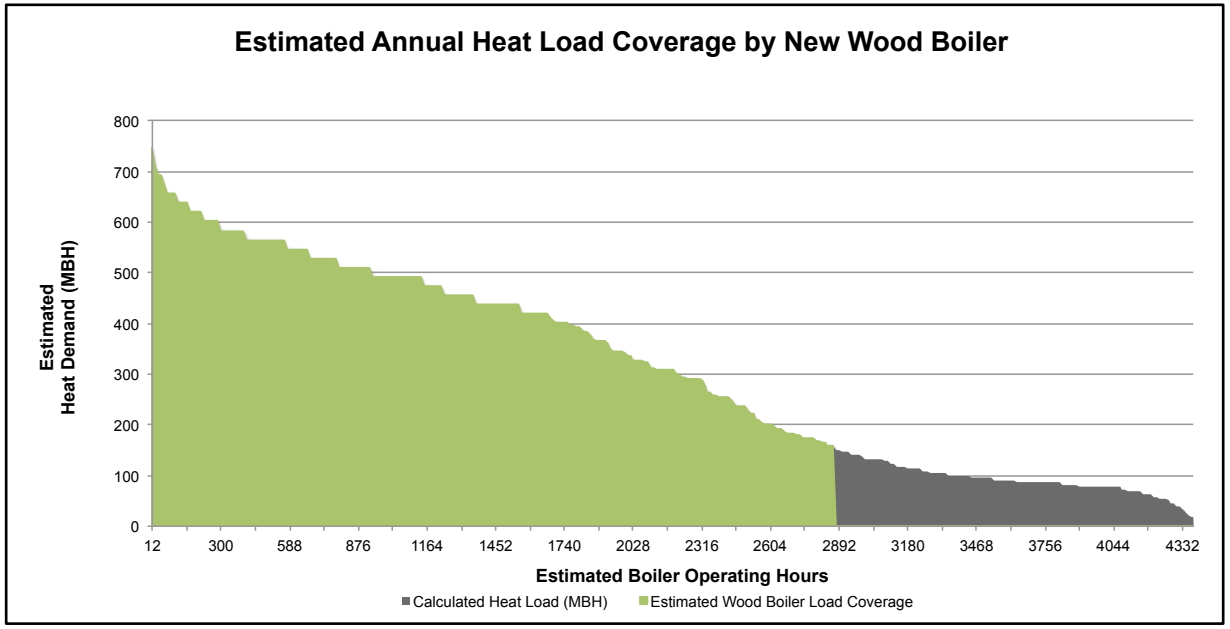
USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy
Energy Calculations

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

Boiler Option Wood-Fired Heating and Cooling
System Output (MBH) 750
Fuel Type Conditioned Forest Biomass (<2" ·
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us



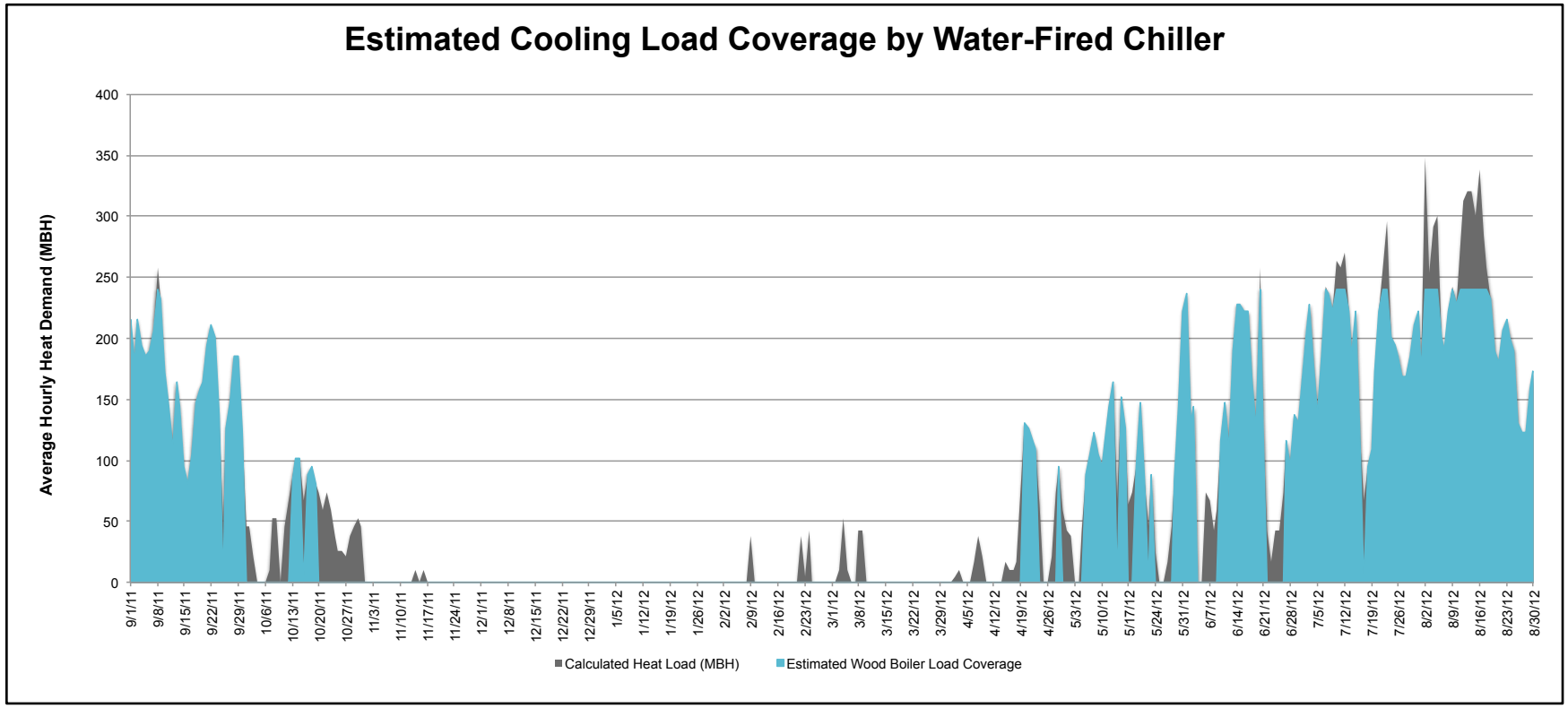
Boiler Output [MBH]	Fossil Fuel Displaced
34	11%
89	28%
136	39%
177	48%
205	53%
266	64%
341	76%
512	90%
750	90%
1024	86%
1365	82%
1842	70%
2457	47%
3241	5%
4265	0%
5459	0%
7165	0%
10236	0%
13648	0%
17060	0%
20472	0%
23884	0%
27296	0%
30708	0%
34120	0%

USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy

Energy Calculations -COOLING

Project	USFS Supervisor's Office - Quincy	**System Description**	Wood-Fired Heating and Cooling	**Contact**	Andrew Haden
Location	Plumas, OR	**System Output (MBH)**	240	**Phone**	(503) 706-6187
Contact	Earl Ford	**Fuel Type**	Conditioned Forest Biomass (<2" ·	**Email**	andrew@wisewood.us
Date	7/9/13	**Workbook Version**	3.7.1		



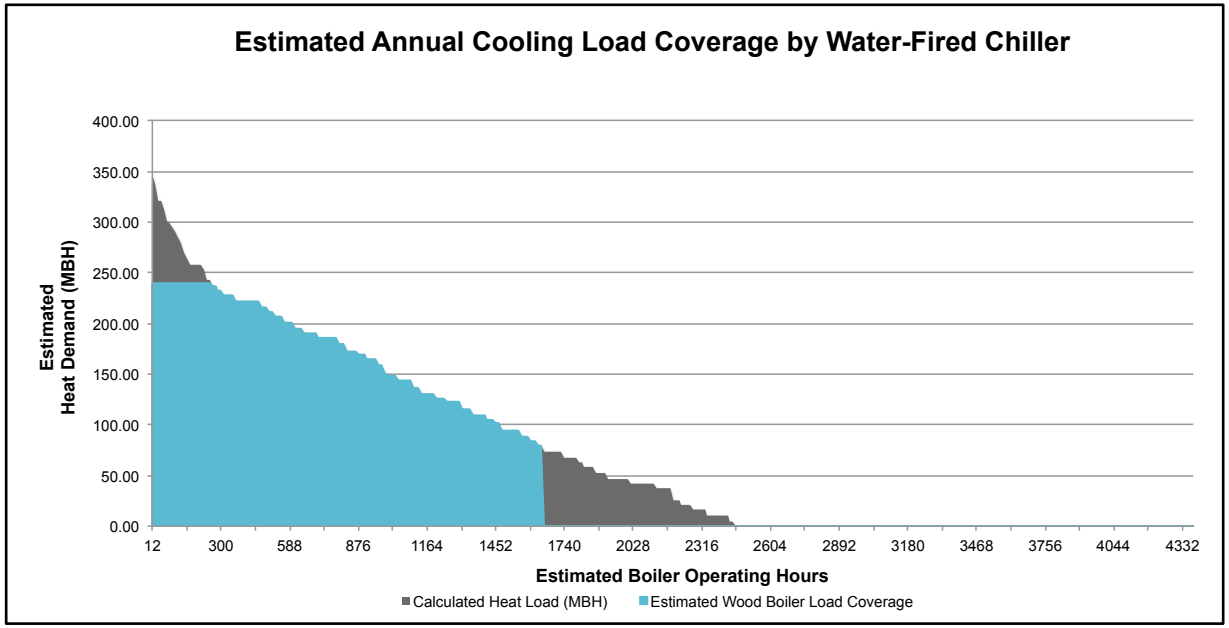
USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy
Energy Calculations -COOLING

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Heating and Cooling
System Output (MBH) 240
Fuel Type Conditioned Forest Biomass (<2" ·
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us



Chiller Output [MBH]	Fossil Fuel Displaced
17	13%
34	24%
51	34%
68	43%
85	52%
102	60%
119	66%
136	71%
154	75%
171	79%
188	83%
205	85%
222	87%
239	86%
256	87%
273	86%
341	81%
512	62%
682	29%
853	12%
1024	3%
1365	0%
1706	0%
2047	0%
3412	0%

USFS Supervisor's Office - Quincy

WORKBOOK VERSION: 3.7.1

Wood-Fired Heating and Cooling **System Output (MBH)** 750 ORIG. DATE: 17-Jun-13

DRAFT PRELIMINARY SUMMARY COST ESTIMATE **Contact** Earl Ford REV. DATE: 09-Jul-13

NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	EST HRS	INSTALL. EQUIPMENT	INSTALL. MATERIALS	INSTALL. LABOR	TOTAL
I	**CIVIL/STRUCTURAL:**				160	$10,000	$30,000	$20,000	$60,000
II	**MECHANICAL INSTALLATION:**				1776	$30,000	$570,000	$140,000	$740,000
III	**PERMITING**					$0	$10,000	$0	$10,000
IV	**MISCELLANEOUS:**					$10,000	$0	$0	$10,000
V	**ELECTRICAL:**				400	$0	$30,000	$30,000	$60,000
			TOTAL DIRECT COST:		2336	$50,000	$640,000	$190,000	$880,000
VI	**INDIRECT COSTS:**								
	GENERAL CONTRACTOR O&P								$150,000
	ENGINEERING, CONSTRUCTION MANAGEMENT & COMMISSIONING								$100,000
VII	**10% UNLISTED ITEMS ALLOWANCE**								$110,000
VIII	**11% CONTINGENCY ALLOWANCE**								$120,000
			TOTAL CAPITAL COST:						$1,360,000
IX	**ITEMS NOT IN THIS ESTIMATE**								
	COMPLIANCE TESTING								
	ENVIRONMENTAL ENGINEERING								
	STORM WATER SYSTEM								
	ASH OR RESIDUAL DISPOSAL OFF-SITE								
	TAXES NOT INCLUDED								

USFS Supervisor's Office - Quincy

Proforma Project Financial Statement

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

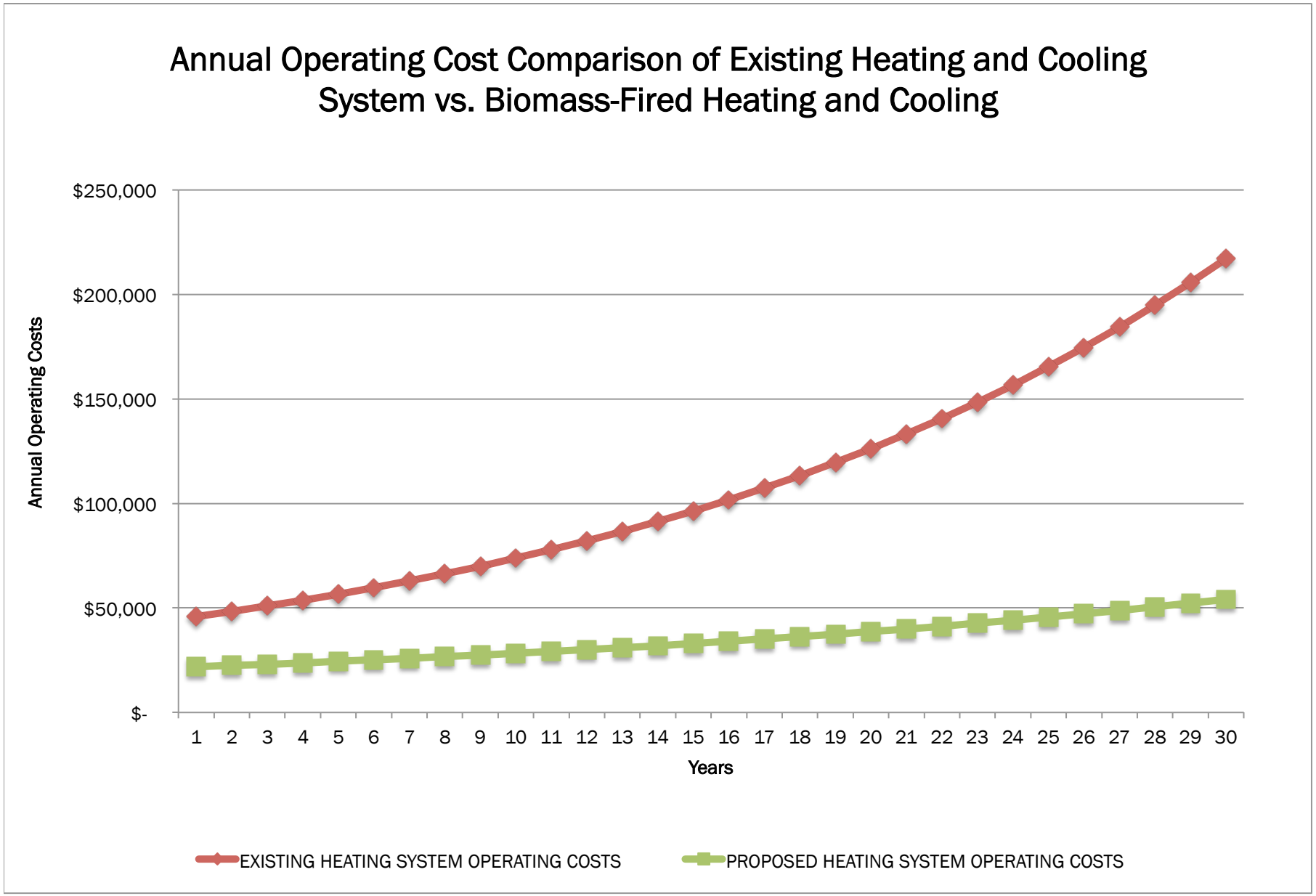
System Description Wood-Fired Heating and Cooling
System Output (MBH) 750
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

DEBT SERVICE		
Total Installation Cost		$ 1,360,000
Grants	0%	$ -
Debt Leverage		0.0%
Project Equity		100.0%
Loan Amount		$ -
Amount of Equity		$ 1,360,000
Annual Rate		5.0%
Term (Years)		30.00

FUEL COSTS	Fossil Fuel	Wood	Electricity
Unit	(mmBtu)	(mmBtu)	(kWhr)
Cost per unit	$26.42	$8.13	$0.17
Escalation Rate	5.8%	2.0%	3.0%

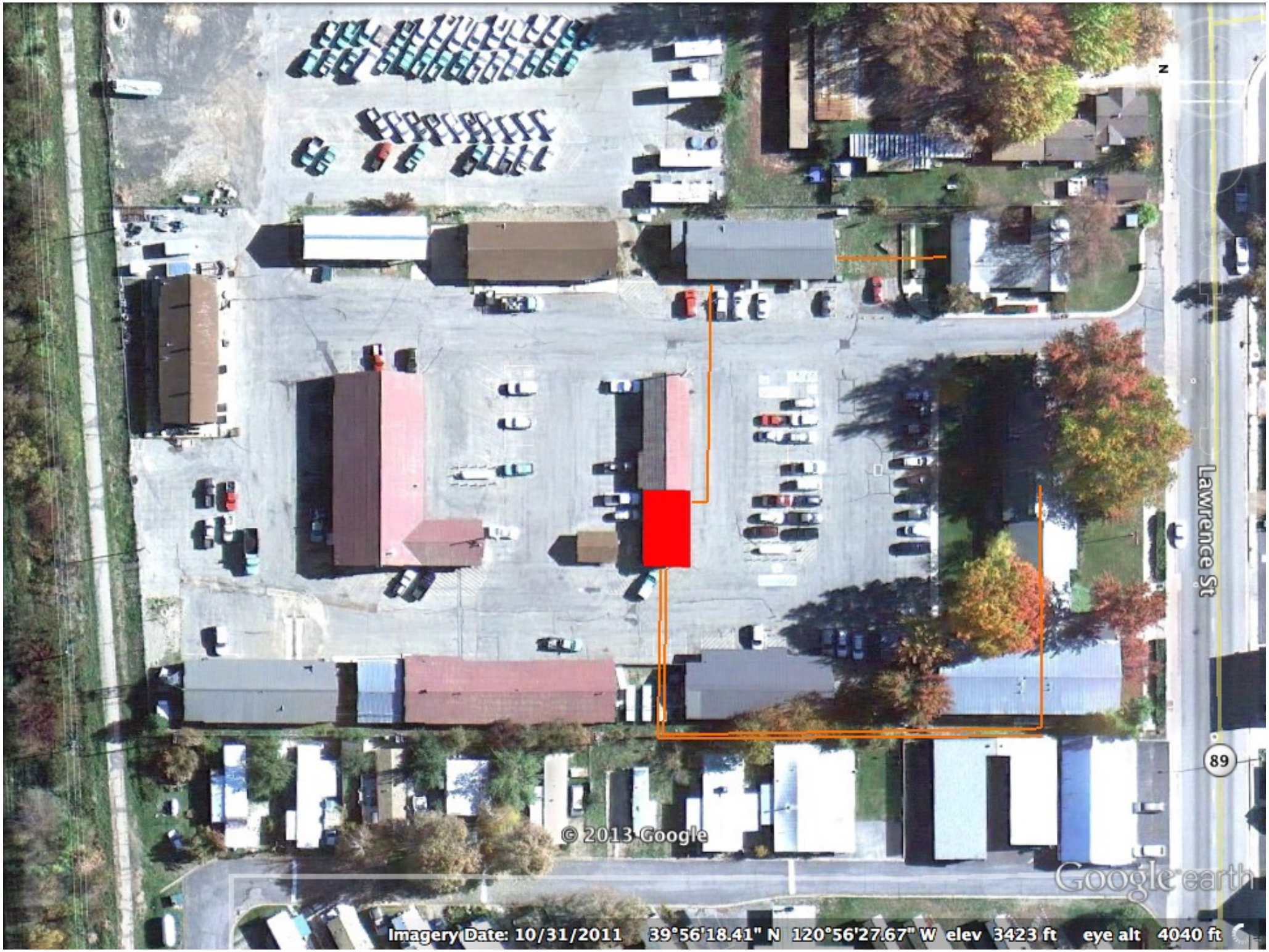
O&M, WOOD	Labor		Electricity
Labor (hrs/wk)	2	Max. electrical draw (kW)	0.5
$/hr	$30	Average draw (kW)	0.3
Wk/yr	40	Annual use (kWhr)	806.9
Total/yr	$2,400	Annual cost, pellet boiler	$136
Ann. increase	2%	Oil boiler, blower, kW	5.0
		Oil boiler, elec. kWh	$0

30 YR ACCUMULATED CASH FLOW	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
EXISTING HEATING SYSTEM OPERATING COSTS														
Existing Heating System Replacment Cost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Projected Heating Oil Cost	$ 39,574	$ 41,870	$ 44,298	$ 46,868	$ 49,586	$ 52,462	$ 55,505	$ 58,724	$ 62,130	$ 65,733	$ 87,139	$ 115,516	$ 153,134	$ 203,002
O&M Cost	$ 1,200	$ 1,224	$ 1,248	$ 1,273	$ 1,299	$ 1,325	$ 1,351	$ 1,378	$ 1,406	$ 1,434	$ 1,583	$ 1,748	$ 1,930	$ 2,131
Projected Cooling Cost	$ 5,100	$ 5,253	$ 5,411	$ 5,573	$ 5,740	$ 5,912	$ 6,090	$ 6,272	$ 6,461	$ 6,654	$ 7,714	$ 8,943	$ 10,367	$ 12,018
TOTAL	**$ 45,874**	**$ 48,347**	**$ 50,957**	**$ 53,714**	**$ 56,625**	**$ 59,699**	**$ 62,946**	**$ 66,375**	**$ 69,996**	**$ 73,822**	**$ 86,640**	**$ 126,207**	**$ 165,431**	**$ 217,151**
PROPOSED HEATING SYSTEM OPERATING COSTS														
Heating Oil Fuel Cost (Peak and Low Load)	$ 3,933	$ 4,162	$ 4,403	$ 4,658	$ 4,928	$ 5,214	$ 5,517	$ 5,837	$ 6,175	$ 6,533	$ 8,661	$ 11,481	$ 15,220	$ 20,177
Wood Fuel Cost	$ 11,576	$ 11,808	$ 12,044	$ 12,285	$ 12,530	$ 12,781	$ 13,037	$ 13,297	$ 13,563	$ 13,835	$ 15,275	$ 16,864	$ 18,620	$ 20,558
O&M Cost	$ 2,400	$ 2,448	$ 2,497	$ 2,547	$ 2,598	$ 2,650	$ 2,703	$ 2,757	$ 2,812	$ 2,868	$ 3,167	$ 3,496	$ 3,860	$ 4,262
Electrical Cost	$ 136	$ 140	$ 144	$ 148	$ 153	$ 157	$ 162	$ 167	$ 172	$ 177	$ 205	$ 238	$ 276	$ 319
Water-Fired Chiller Cooling Costs	$ 3,795	$ 3,871	$ 3,987	$ 4,107	$ 4,230	$ 4,357	$ 4,488	$ 4,622	$ 4,761	$ 4,904	$ 5,685	$ 6,590	$ 7,640	$ 8,857
TOTAL	**$ 21,840**	**$ 22,428**	**$ 23,075**	**$ 23,745**	**$ 24,439**	**$ 25,159**	**$ 25,906**	**$ 26,680**	**$ 27,483**	**$ 28,317**	**$ 32,992**	**$ 38,670**	**$ 45,616**	**$ 54,172**
PROJECT RELATED DEBT														
Beginning Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Principal Repayments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL DEBT PAYMENT	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
ANNUAL OPERATING COST SAVINGS (LOSS)	**$ 24,034**	**$ 25,919**	**$ 27,883**	**$ 29,969**	**$ 32,186**	**$ 34,540**	**$ 37,040**	**$ 39,695**	**$ 42,513**	**$ 45,505**	**$ 63,445**	**$ 87,537**	**$ 119,816**	**$ 162,979**
Cash Investment (equity)	$ (1,360,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Income (cost savings)	$ 24,034	$ 25,919	$ 27,883	$ 29,969	$ 32,186	$ 34,540	$ 37,040	$ 39,695	$ 42,513	$ 45,505	$ 63,445	$ 87,537	$ 119,816	$ 162,979
Net Cash Flow	**$ (1,335,966)**	**$ 25,919**	**$ 27,883**	**$ 29,969**	**$ 32,186**	**$ 34,540**	**$ 37,040**	**$ 39,695**	**$ 42,513**	**$ 45,505**	**$ 63,445**	**$ 87,537**	**$ 119,816**	**$ 162,979**
ACCUMULATED CASH FLOW	$ (1,335,966)	$ (1,310,047)	$ (1,282,164)	$ (1,252,195)	$ (1,220,010)	$ (1,185,470)	$ (1,148,430)	$ (1,108,735)	$ (1,066,222)	$ (1,020,717)	$ (741,495)	$ (354,819)	$ 175,945	$ 899,516


Annual Operating Cost Comparison of Existing Heating and Cooling System vs. Biomass-Fired Heating and Cooling
Annual Operating Costs
$250,000
$200,000
$150,000
$100,000
$50,000
$-
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Years
EXISTING HEATING SYSTEM OPERATING COSTS
PROPOSED HEATING SYSTEM OPERATING COSTS

Supervisor's Office

Scenario 2: Main Buildings (2000, 2001, 2200, 2301), Heating Only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Lawrence St
89
© 2013 Google
Google earth
Imagery Date: 10/31/2011 39°56'18.41" N 120°56'27.67" W elev 3423 ft eye alt 4040 ft

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

Bldgs: 2000, 2001, 2200, 2301

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Heat Only
System Output (MBH) 500
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us
Address 1001 SE Water Ave, Suite 255
Portland, OR 97214

Exisiting fossil fuel consumption (MMBtu/HDD)	0.210	Max. electrical demand (kW)	0.5	Current heating oil use, [gal/yr]	3,500
Existing Furnace Eff.	90%	Average electrical demand (kW)	0.3	Current propane use, [gal/yr]	8,793
Calculated exisiting heat input (MMBtu/HDD)	0.189	Annual use (kWhr)	1065	Current heating oil cost, [$/yr]	$13,125
Efficiency gains (via EEMs)	0%	Estimated reduction in heating oil use	91%	Current propane cost, [$/yr]	$20,927
Wood Boiler Eff.	85.0%	Boiler output, high-fire (MBH)	500	Projected wood fuel use, [tons/yr]	102
Heating oil cost, $/gal.	$3.75	Boiler output, low-fire (MBH)	100	Projected propane use, [gal/yr]	1,217
Propane cost, $/gal.	$2.38	Average boiler output (MBH)	336	Projected wood fuel use, [$/yr]	$10,188
Electricity cost, $/kWhr	0.17	Wood MC, wet weight basis	25%	Projected heating oil use, [$/yr]	$2,896
Wood fuel cost, $/green ton	$100.00	Energy of Wood, mmBtu/ton, LHV	12.3	Projected electricity cost, [$/yr]	$85
Fossil fuel cost, $/mmBtu	$26.42	Energy of heating oil, Btu/gal, HHV	139000	Operating hours per day	12
Wood fuel cost, $/mmBtu	$8.13	Energy of propane, Btu/gal, HHV	92000	Operating hours, yr	3168

Month	Applicable Heating Degree Days [HDD]	Current gross fossil energy consumption, [MMBtu]	Current net space heat energy input [MMBtu]	Projected net space heat input after EEMs [mmBtu/mo]	Projected gross wood energy consumption, [MMBtu]	Projected gross fossil energy consumption, [MMBtu]
September	163	34	31	31	33	9
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April	541	114	102	102	110	6
May	328	69	62	62	67	4
June	231	49	44	44	47	3
July	140	29	27	27	29	2
August	126	26	24	24	26	0
Yearly Total, or Avg.	6162	1,295	1,166	1,166	1,253	109

Net fossil energy savings, [MMBtu/yr] **1,186**

PRELIMINARY

DRAFT- FOR COMMENT

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Heat Only
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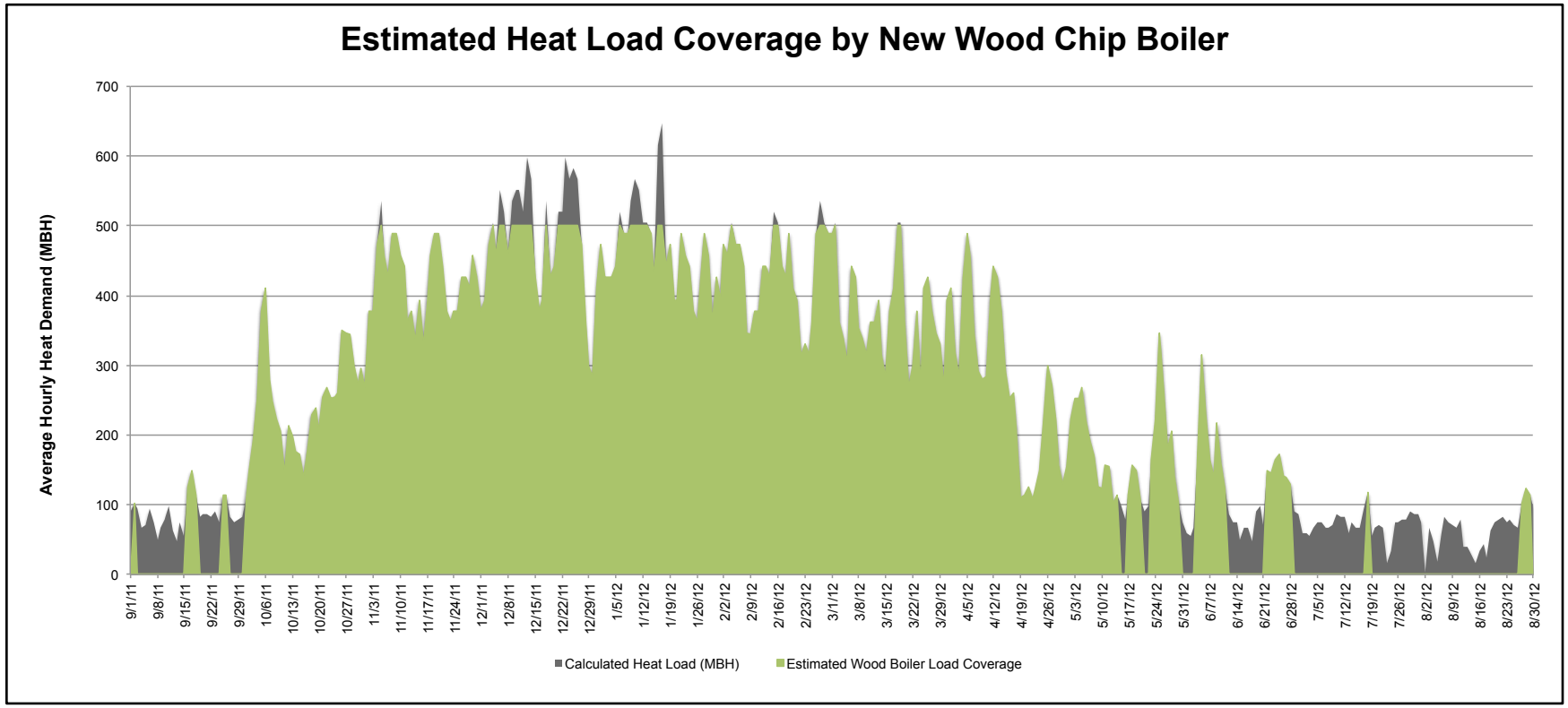

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

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Location Plumas, OR
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Boiler Option Wood-Fired Boiler - Heat Only
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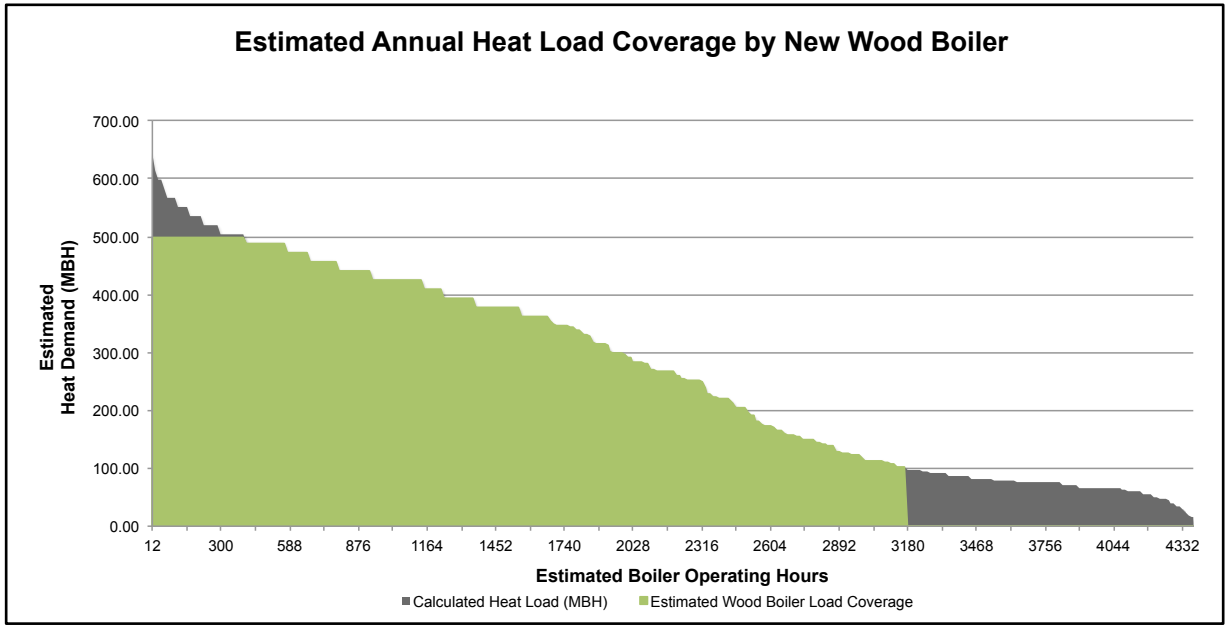


Boiler Output [MBH]	Fossil Fuel Displaced
34	13%
89	31%
136	44%
177	53%
205	59%
266	71%
341	82%
500	91%
750	88%
1024	85%
1365	76%
1842	61%
2457	18%
3241	0%
4265	0%
5459	0%
7165	0%
10236	0%
13648	0%
17060	0%
20472	0%
23884	0%
27296	0%
30708	0%
34120	0%

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Heat Only **System Output (MBH)** 500

DRAFT PRELIMINARY BUDGETARY SUMMARY COST ESTIMATE **Contact** Earl Ford

WORKBOOK VERSION: 3.7.1
ORIG. DATE: 17-Jun-13
REV. DATE: 09-Jul-13

NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	EST HRS	INSTALL. EQUIPMENT	INSTALL. MATERIALS	INSTALL. LABOR	TOTAL
I	**CIVIL/STRUCTURAL:**				160	$10,000	$30,000	$20,000	$60,000
II	**MECHANICAL INSTALLATION:**				1176	$30,000	$350,000	$80,000	$460,000
III	**PERMITING**					$0	$10,000	$0	$10,000
IV	**MISCELLANEOUS:**					$10,000	$0	$0	$10,000
V	**ELECTRICAL:**				320	$0	$30,000	$30,000	$60,000
			TOTAL DIRECT COST:		1656	$50,000	$420,000	$130,000	$600,000
VI	**INDIRECT COSTS:**								
	GENERAL CONTRACTOR O&P								$100,000
	ENGINEERING, CONSTRUCTION MANAGEMENT & COMMISSIONING								$70,000
VII	**10% UNLISTED ITEMS ALLOWANCE**								$80,000
VIII	**11% CONTINGENCY ALLOWANCE**								$80,000
			TOTAL CAPITAL COST:						$930,000
IX	**ITEMS NOT IN THIS ESTIMATE**								
	COMPLIANCE TESTING								
	ENVIRONMENTAL ENGINEERING								
	STORM WATER SYSTEM								
	ASH OR RESIDUAL DISPOSAL OFF-SITE								
	TAXES NOT INCLUDED								

USFS Supervisor's Office - Quincy

Proforma Project Financial Statement

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

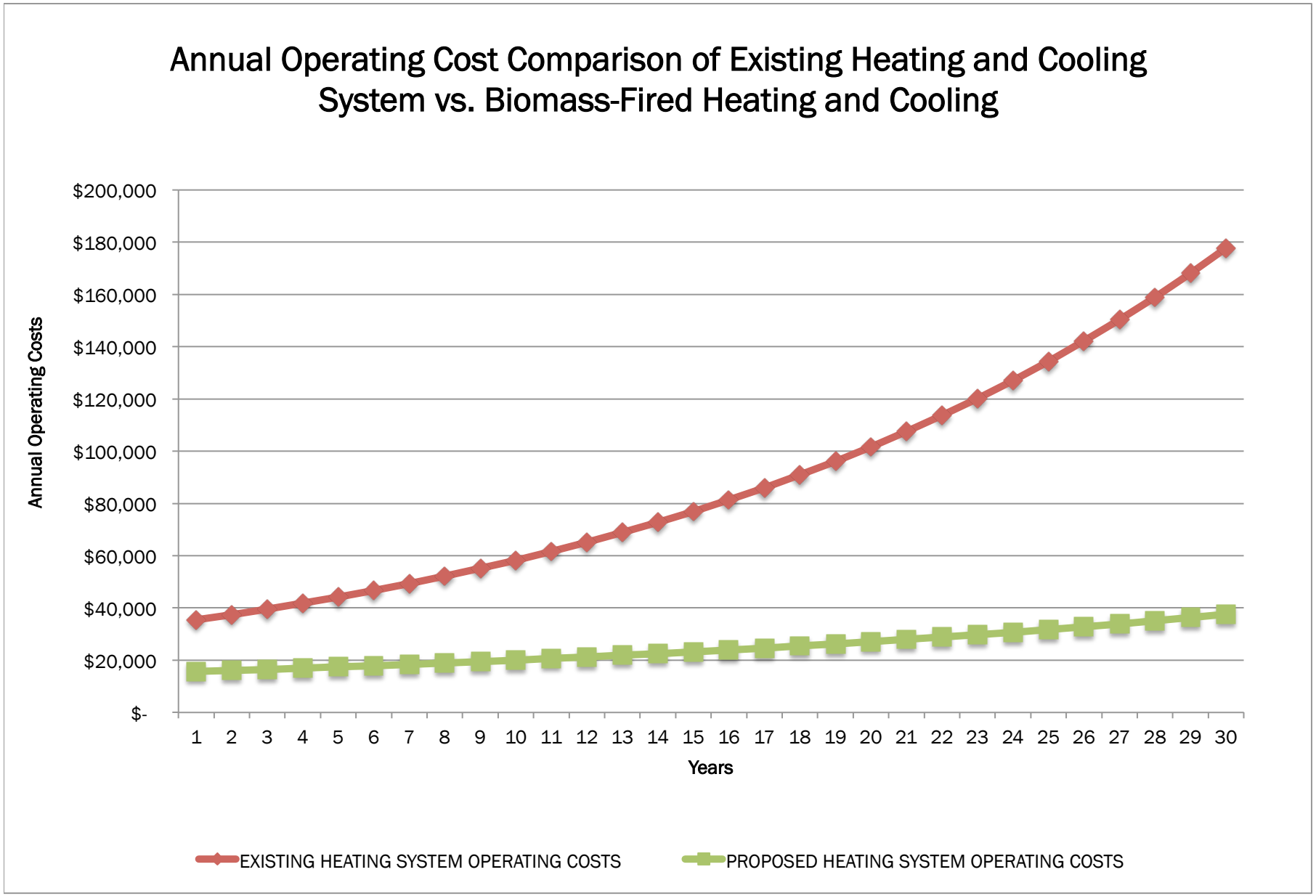
System Description Heat Only
System Output (MBH) 500
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

DEBT SERVICE		
Total Installation Cost		$ 930,000
Grants	0%	$ -
Debt Leverage		0.0%
Project Equity		100.0%
Loan Amount		$ -
Amount of Equity		$ 930,000
Annual Rate		5.0%
Term (Years)		30.00

FUEL COSTS	Fossil Fuel	Wood	Electricity
Unit	(mmBtu)	(mmBtu)	(kWhr)
Cost per unit	$26.42	$8.13	$0.17
Escalation Rate	5.8%	2.0%	3.0%

O&M, WOOD	Labor		Electricity
Labor (hrs/wk)	2	Max. electrical draw (kW)	0.5
$/hr	$30	Average draw (kW)	0.3
Wk/yr	40	Annual use (kWhr)	1065.1
Total/yr	$2,400	Annual cost, pellet boiler	$179
Ann. increase	2%	Oil boiler, blower, kW	5.0
		Oil boiler, elec. kWh	$0

30 YR ACCUMULATED CASH FLOW	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
EXISTING HEATING SYSTEM OPERATING COSTS														
Existing Heating System Replacment Cost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Projected Heating Oil Cost	$ 34,231	$ 36,216	$ 38,317	$ 40,539	$ 42,890	$ 45,378	$ 48,010	$ 50,794	$ 53,740	$ 56,857	$ 75,373	$ 99,918	$ 132,456	$ 175,590
O&M Cost	$ 1,200	$ 1,224	$ 1,248	$ 1,273	$ 1,299	$ 1,325	$ 1,351	$ 1,378	$ 1,406	$ 1,434	$ 1,583	$ 1,748	$ 1,930	$ 2,131
TOTAL	**$ 35,431**	**$ 37,440**	**$ 39,565**	**$ 41,812**	**$ 44,189**	**$ 46,703**	**$ 49,361**	**$ 52,173**	**$ 55,146**	**$ 58,291**	**$ 68,857**	**$ 101,666**	**$ 134,386**	**$ 177,721**
PROPOSED HEATING SYSTEM OPERATING COSTS														
Heating Oil Fuel Cost (Peak and Low Load)	$ 2,880	$ 3,047	$ 3,224	$ 3,411	$ 3,609	$ 3,818	$ 4,039	$ 4,274	$ 4,521	$ 4,784	$ 6,341	$ 8,407	$ 11,144	$ 14,773
Wood Fuel Cost	$ 10,188	$ 10,392	$ 10,599	$ 10,811	$ 11,028	$ 11,248	$ 11,473	$ 11,703	$ 11,937	$ 12,175	$ 13,443	$ 14,842	$ 16,386	$ 18,092
O&M Cost	$ 2,400	$ 2,448	$ 2,497	$ 2,547	$ 2,598	$ 2,650	$ 2,703	$ 2,757	$ 2,812	$ 2,868	$ 3,167	$ 3,496	$ 3,860	$ 4,262
Electrical Cost	$ 179	$ 184	$ 190	$ 196	$ 201	$ 207	$ 214	$ 220	$ 227	$ 233	$ 271	$ 314	$ 364	$ 422
TOTAL	**$ 15,647**	**$ 16,071**	**$ 16,510**	**$ 16,965**	**$ 17,435**	**$ 17,923**	**$ 18,429**	**$ 18,953**	**$ 19,497**	**$ 20,061**	**$ 23,222**	**$ 27,058**	**$ 31,755**	**$ 37,549**
PROJECT RELATED DEBT														
Beginning Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Principal Repayments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL DEBT PAYMENT	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
ANNUAL OPERATING COST SAVINGS (LOSS)	**$ 19,784**	**$ 21,369**	**$ 23,055**	**$ 24,848**	**$ 26,754**	**$ 28,779**	**$ 30,932**	**$ 33,220**	**$ 35,650**	**$ 38,231**	**$ 53,735**	**$ 74,607**	**$ 102,631**	**$ 140,172**
Cash Investment (equity)	$ (930,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Income (cost savings)	$ 19,784	$ 21,369	$ 23,055	$ 24,848	$ 26,754	$ 28,779	$ 30,932	$ 33,220	$ 35,650	$ 38,231	$ 53,735	$ 74,607	$ 102,631	$ 140,172
Net Cash Flow	**$ (910,216)**	**$ 21,369**	**$ 23,055**	**$ 24,848**	**$ 26,754**	**$ 28,779**	**$ 30,932**	**$ 33,220**	**$ 35,650**	**$ 38,231**	**$ 53,735**	**$ 74,607**	**$ 102,631**	**$ 140,172**
ACCUMULATED CASH FLOW	$ (910,216)	$ (888,847)	$ (865,792)	$ (840,944)	$ (814,191)	$ (785,411)	$ (754,479)	$ (721,259)	$ (685,610)	$ (647,379)	$ (411,566)	$ (82,741)	$ 371,084	$ 992,492


Annual Operating Cost Comparison of Existing Heating and Cooling System vs. Biomass-Fired Heating and Cooling
Annual Operating Costs
$200,000
$180,000
$160,000
$140,000
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$-
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Years
EXISTING HEATING SYSTEM OPERATING COSTS
PROPOSED HEATING SYSTEM OPERATING COSTS

Mount Hough Ranger District

Scenario 1: Main Buildings (2000, 2361, 2375, 2370), Heating Only

USFS Mt Hough Ranger District

USFS Mt Hough Ranger District
Energy Calculations
Bldgs: 2000, 2361, 2375, 2370

Project USFS Mt Hough Ranger District
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Boiler
System Output (MBH) 250
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us
Address 1001 SE Water Ave, Suite 255
Portland, OR 97214

Exisiting fossil fuel consumption (MMBtu/HDD)	0.099	Max. electrical demand (kW)	0.2	Current heating oil use, [gal/yr]	0
Existing Furnace Eff.	90%	Average electrical demand (kW)	0.1	Current propane use, [gal/yr]	6,650
Calculated exisiting heat input (MMBtu/HDD)	0.089	Annual use (kWhr)	371	Current heating oil cost, [$/yr]	$0
Efficiency gains (via EEMs)	0%	Estimated reduction in heating oil use	92%	Current propane cost, [$/yr]	$15,761
Wood Boiler Eff.	85.0%	Boiler output, high-fire (MBH)	250	Projected wood fuel use, [tons/yr]	48
Heating oil cost, $/gal.	$3.75	Boiler output, low-fire (MBH)	50	Projected propane use, [gal/yr]	555
Propane cost, $/gal.	$2.37	Average boiler output (MBH)	162	Projected wood fuel use, [$/yr]	$4,827
Electricity cost, $/kWhr	0.17	Wood MC, wet weight basis	25%	Projected heating oil use, [$/yr]	$1,316
Wood fuel cost, $/green ton	$100.00	Energy of Wood, mmBtu/ton, LHV	12.3	Projected electricity cost, [$/yr]	$30
Fossil fuel cost, $/mmBtu	$26.37	Energy of heating oil, Btu/gal, HHV	139000	Operating hours per day	12
Wood fuel cost, $/mmBtu	$8.13	Energy of propane, Btu/gal, HHV	92000	Operating hours, yr	2868

Month	Applicable Heating Degree Days [HDD]	Current gross fossil energy consumption, [MMBtu]	Current net space heat energy input [MMBtu]	Projected net space heat input after EEMs [mmBtu/mo]	Projected gross wood energy consumption, [MMBtu]	Projected gross fossil energy consumption, [MMBtu]
September	163	16	15	15	16	4
October	479	48	43	43	46	7
November	793	79	71	71	76	8
December	942	94	84	84	91	8
January	921	91	82	82	89	6
February	762	76	68	68	73	6
March	737	73	66	66	71	4
April	541	54	48	48	52	3
May	328	33	29	29	32	2
June	231	23	21	21	22	1
July	140	14	13	13	14	1
August	126	13	11	11	12	0
Yearly Total, or Avg.	6162	612	551	551	594	50

Net fossil energy savings, [MMBtu/yr] **562**

PRELIMINARY

DRAFT - FOR COMMMENT

USFS Mt Hough Ranger District

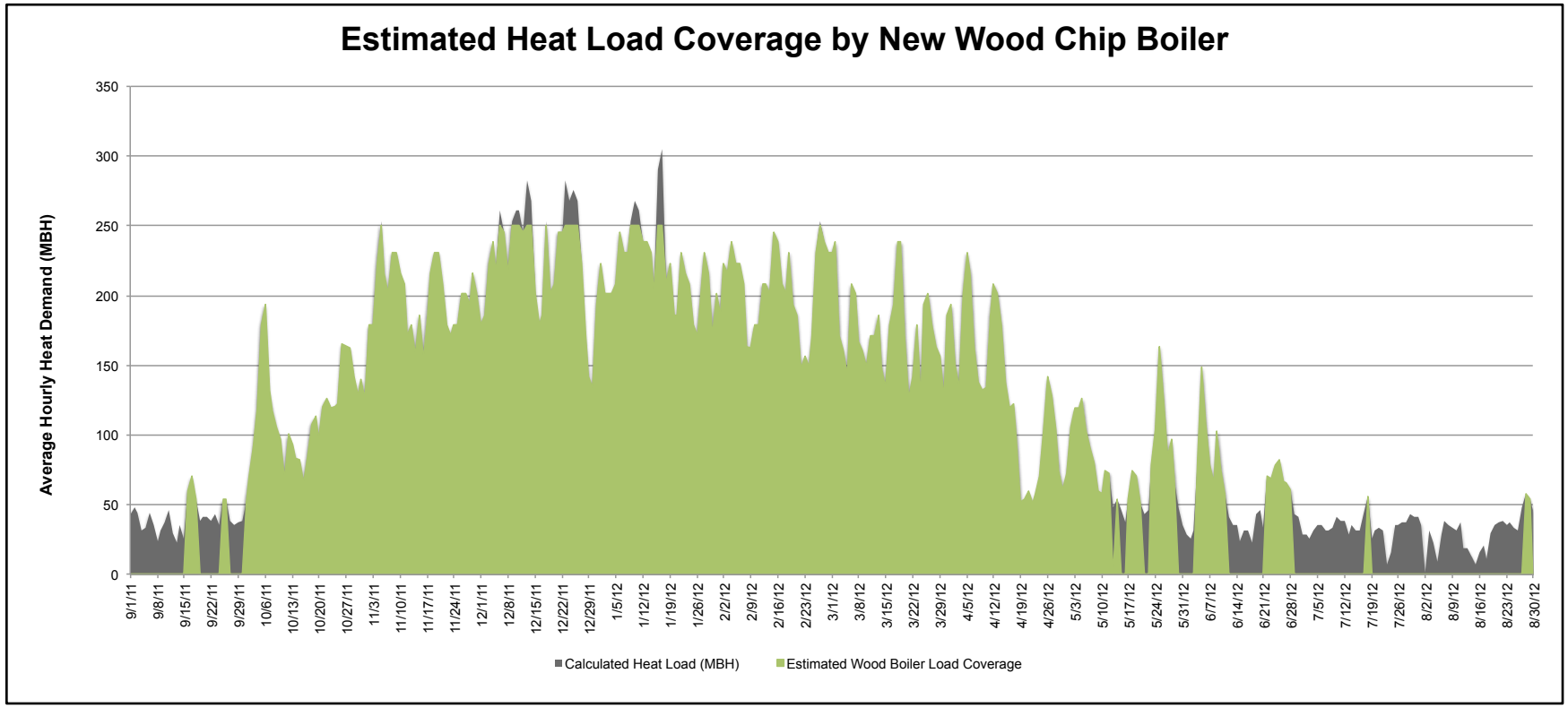
USFS Mt Hough Ranger District

Energy Calculations Bldgs: 2000, 2361, 2375, 2370

Project USFS Mt Hough Ranger District
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Boiler
System Output (MBH) 250
Fuel Type Conditioned Forest Biomass (<2" ·
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us



USFS Mt Hough Ranger District

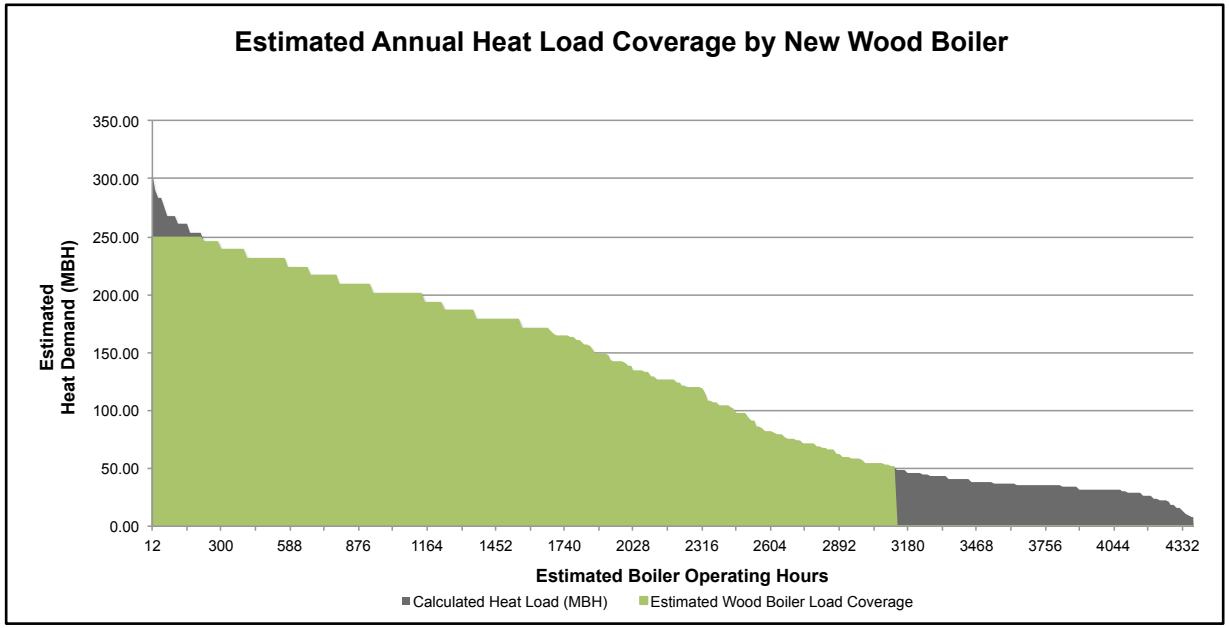
USFS Mt Hough Ranger District

Energy Calculations Bldgs: 2000, 2361, 2375, 2370

Project USFS Mt Hough Ranger District
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

Boiler Option Wood-Fired Boiler
System Output (MBH) 250
Fuel Type Conditioned Forest Biomass (<2" ·
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us



Boiler Output [MBH]	Fossil Fuel Displaced
34	26%
89	55%
136	75%
177	86%
205	90%
250	92%
341	89%
512	84%
750	70%
1024	39%
1365	3%
1842	0%
2457	0%
3241	0%
4265	0%
5459	0%
7165	0%
10236	0%
13648	0%
17060	0%
20472	0%
23884	0%
27296	0%
30708	0%
34120	0%

USFS Mt Hough Ranger District

WISEWOOD inc

WORKBOOK VERSION: 3.7.1

Wood-Fired Boiler **System Output (MBH)** 250 ORIG. DATE: 17-Jun-13

DRAFT PRELIMINARY SUMMARY COST ESTIMATE **Contact** Earl Ford REV. DATE: 09-Jul-13

NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	EST HRS	INSTALL. EQUIPMENT	INSTALL. MATERIALS	INSTALL. LABOR	TOTAL
I	**CIVIL/STRUCTURAL:**				160	$0	$30,000	$20,000	$50,000
II	**MECHANICAL INSTALLATION:**				936	$30,000	$170,000	$70,000	$270,000
III	**PERMITING**					$0	$10,000	$0	$10,000
IV	**MISCELLANEOUS:**					$10,000	$0	$0	$10,000
V	**ELECTRICAL:**				200	$0	$20,000	$20,000	$40,000
			TOTAL DIRECT COST:		1296	$40,000	$230,000	$110,000	$380,000
VI	**INDIRECT COSTS:**								
	GENERAL CONTRACTOR O&P								$70,000
	ENGINEERING, CONSTRUCTION MANAGEMENT & COMMISSIONING								$40,000
VII	**10% UNLISTED ITEMS ALLOWANCE**								$50,000
VIII	**11% CONTINGENCY ALLOWANCE**								$50,000
			TOTAL CAPITAL COST:						$590,000
IX	**ITEMS NOT IN THIS ESTIMATE**								
	COMPLIANCE TESTING								
	ENVIRONMENTAL ENGINEERING								
	STORM WATER SYSTEM								
	ASH OR RESIDUAL DISPOSAL OFF-SITE								
	TAXES NOT INCLUDED								

USFS Mt Hough Ranger District

Proforma Project Financial Statement

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us

Project USFS Mt Hough Ranger District
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Boiler
System Output (MBH) 250
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

DEBT SERVICE		
Total Installation Cost		$ 590,000
Grants	0%	$ -
Debt Leverage		0.0%
Project Equity		100.0%
Loan Amount		$ -
Amount of Equity		$ 590,000
Annual Rate		5.0%
Term (Years)		30.00

FUEL COSTS	Fossil Fuel	Wood	Electricity
Unit	(mmBtu)	(mmBtu)	(kWhr)
Cost per unit	$26.37	$8.13	$0.17
Escalation Rate	5.8%	2.0%	3.0%

O&M, WOOD	Labor		Electricity
Labor (hrs/wk)	2	Max. electrical draw (kW)	0.2
$/hr	$30	Average draw (kW)	0.1
Wk/yr	40	Annual use (kWhr)	371.1
Total/yr	$2,400	Annual cost, pellet boiler	$62
Ann. increase	2%	Oil boiler, blower, kW	5.0
		Oil boiler, elec. kWh	$0

30 YR ACCUMULATED CASH FLOW	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
EXISTING HEATING SYSTEM OPERATING COSTS														
Existing Heating System Replacment Cost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Projected Heating Oil Cost	$ 16,133	$ 17,069	$ 18,059	$ 19,106	$ 20,214	$ 21,387	$ 22,627	$ 23,939	$ 25,328	$ 26,797	$ 35,523	$ 47,091	$ 62,427	$ 82,756
O&M Cost	$ 1,200	$ 1,224	$ 1,248	$ 1,273	$ 1,299	$ 1,325	$ 1,351	$ 1,378	$ 1,406	$ 1,434	$ 1,583	$ 1,748	$ 1,930	$ 2,131
TOTAL	**$ 17,333**	**$ 18,293**	**$ 19,307**	**$ 20,379**	**$ 21,513**	**$ 22,712**	**$ 23,978**	**$ 25,318**	**$ 26,734**	**$ 28,231**	**$ 33,257**	**$ 48,840**	**$ 64,357**	**$ 84,887**
PROPOSED HEATING SYSTEM OPERATING COSTS														
Heating Oil Fuel Cost (Peak and Low Load)	$ 1,312	$ 1,388	$ 1,468	$ 1,554	$ 1,644	$ 1,739	$ 1,840	$ 1,947	$ 2,060	$ 2,179	$ 2,889	$ 3,829	$ 5,076	$ 6,729
Wood Fuel Cost	$ 4,827	$ 4,923	$ 5,022	$ 5,122	$ 5,225	$ 5,329	$ 5,436	$ 5,544	$ 5,655	$ 5,768	$ 6,369	$ 7,032	$ 7,763	$ 8,571
O&M Cost	$ 2,400	$ 2,448	$ 2,497	$ 2,547	$ 2,598	$ 2,650	$ 2,703	$ 2,757	$ 2,812	$ 2,868	$ 3,167	$ 3,496	$ 3,860	$ 4,262
Electrical Cost	$ 62	$ 64	$ 66	$ 68	$ 70	$ 72	$ 74	$ 77	$ 79	$ 81	$ 94	$ 109	$ 127	$ 147
TOTAL	**$ 8,601**	**$ 8,823**	**$ 9,053**	**$ 9,291**	**$ 9,536**	**$ 9,790**	**$ 10,053**	**$ 10,325**	**$ 10,606**	**$ 10,897**	**$ 12,518**	**$ 14,467**	**$ 16,827**	**$ 19,710**
PROJECT RELATED DEBT														
Beginning Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Principal Repayments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL DEBT PAYMENT	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
ANNUAL OPERATING COST SAVINGS (LOSS)	**$ 8,732**	**$ 9,469**	**$ 10,254**	**$ 11,089**	**$ 11,977**	**$ 12,921**	**$ 13,926**	**$ 14,993**	**$ 16,128**	**$ 17,334**	**$ 24,588**	**$ 34,373**	**$ 47,530**	**$ 65,177**
Cash Investment (equity)	$ (590,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Income (cost savings)	$ 8,732	$ 9,469	$ 10,254	$ 11,089	$ 11,977	$ 12,921	$ 13,926	$ 14,993	$ 16,128	$ 17,334	$ 24,588	$ 34,373	$ 47,530	$ 65,177
Net Cash Flow	**$ (581,268)**	**$ 9,469**	**$ 10,254**	**$ 11,089**	**$ 11,977**	**$ 12,921**	**$ 13,926**	**$ 14,993**	**$ 16,128**	**$ 17,334**	**$ 24,588**	**$ 34,373**	**$ 47,530**	**$ 65,177**
ACCUMULATED CASH FLOW	$ (581,268)	$ (571,799)	$ (561,545)	$ (550,456)	$ (538,479)	$ (525,558)	$ (511,632)	$ (496,639)	$ (480,511)	$ (463,177)	$ (355,616)	$ (204,483)	$ 5,304	$ 293,833

Annual Operating Cost Comparison of Existing Heating and Cooling System vs. Biomass-Fired Heating and Cooling